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Emerging Biomarkers for Prognosis and Treatment Response in Pulmonary Cancer

Lee Greene*

Department of Pulmonary Medicine, Golden Gate University, San Francisco, CA, USA

Description

Pulmonary cancer, commonly known as lung cancer, remains one of the leading causes of cancer-related mortality worldwide. Its diverse histological subtypes, aggressive nature, and often late-stage diagnosis contribute to its high mortality rates. Traditional diagnostic and prognostic tools, such as histopathological examination and clinical staging, have limitations in predicting treatment response and patient outcomes accurately. In recent years, the field of oncology has seen significant advancements in identifying and utilizing biomarkers – molecular indicators of disease presence, progression, and treatment response. This article delves into the emerging biomarkers that hold promise in improving prognosis and treatment response assessment in pulmonary cancer [1].

Genetic alterations play a crucial role in the development and progression of pulmonary cancer. Mutations in key genes, such as Epidermal Growth Factor Receptor (EGFR), Anaplastic Lymphoma Kinase (ALK), and ROS proto-oncogene 1 (ROS1), have been identified as driver mutations in Non-Small Cell Lung Cancer (NSCLC). Detection of these mutations not only aids in diagnosis but also guides treatment decisions. EGFR mutations, for instance, are associated with increased sensitivity to EGFR Tyrosine Kinase Inhibitors (TKIs) like gefitinib and erlotinib, leading to improved treatment outcomes. Similarly, ALK and ROS1 rearrangements are actionable biomarkers, prompting the use of ALK and ROS1 inhibitors [2].

Immunotherapy has revolutionized cancer treatment by harnessing the patient's immune system to target and destroy cancer cells. Immune Checkpoint Inhibitors (ICIs), such as pembrolizumab and nivolumab, have shown remarkable efficacy in subsets of lung cancer patients. Biomarkers like Programmed Death-Ligand 1 (PD-L1) expression on tumour cells have been used to identify patients more likely to respond to ICIs. However, PD-L1's predictive value is not absolute, and novel immune-related biomarkers are being explored. Tumour Mutational Burden (TMB) – the number of mutations per mega base of the genome – is being investigated as a potential biomarker for immunotherapy response, with higher TMB correlating with increased response rates. Traditional tissue biopsies can be invasive and may not always provide a comprehensive picture of the tumor's heterogeneity, particularly in advanced stages. Liquid biopsies, which involve analysing tumor-derived genetic material circulating in the blood offer a non-invasive alternative. Liquid biopsies can detect genetic mutations, monitor treatment response, and identify emerging resistance mechanisms. They hold promise in guiding treatment decisions, especially in cases where tissue biopsies are challenging to obtain [3-5].

Exosomes are small extracellular vesicles released by cells, containing various biomolecules such as nucleic acids, proteins, and lipids. These vesicles play a role in intercellular communication and have gained attention as potential biomarkers. Exosomal RNA and proteins derived from lung cancer cells can be isolated from patient blood samples. Researchers are exploring the potential of exosome biomarkers in early detection, prognosis assessment, and monitoring treatment response. CTCs are cancer cells that detach from the primary tumor and enter the bloodstream. They have the potential to serve as biomarkers for monitoring disease progression and treatment response. The enumeration and molecular characterization of CTCs can provide insights into the aggressiveness of the tumor and its potential to metastasize. Technologies for isolating and analyzing CTCs are advancing, making their clinical utility more feasible. MicroRNAs (miRNAs) are short RNA molecules that regulate gene expression. Dysregulated miRNA expression is associated with cancer development and progression. MiRNA signatures specific to different lung cancer subtypes have been identified. These signatures can serve as diagnostic and prognostic biomarkers, offering insights into the underlying molecular mechanisms of the disease.

Advancements in medical imaging have enabled the development of imaging biomarkers. Techniques like Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) can provide functional and molecular information about tumours. Radionics, which involves extracting quantitative data from medical images, allows for the identification of features associated with prognosis and treatment response. The landscape of pulmonary cancer management is rapidly evolving, with emerging biomarkers offering the potential to enhance prognosis prediction and treatment response assessment. Genetic, immune-related, liquid biopsy, exosome, CTC, microRNA, metabolomics, and imaging biomarkers are collectively pushing the boundaries of personalized medicine. As research continues, the integration of these biomarkers into clinical practice holds the promise of improving patient outcomes by guiding tailored treatment strategies and enabling early intervention. However, challenges such as standardization, validation, and accessibility must be addressed to fully realize the clinical utility of these emerging biomarkers in the context of pulmonary cancer.

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Conflict of Interest

The authors declare that there is no conflict of interest associated with this manuscript.

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***Address for Correspondence:** Lee Greene, Department of Pulmonary Medicine, Golden Gate University, San Francisco, CA, USA, E-mail: leegreene45@yahoo.com*

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